

ART. XXXIII.—*A Revision of the Species of Limopsis
in the Tertiary Beds of Southern Australia.*

BY FREDERICK CHAPMAN, A.L.S., &c.

Palaeontologist to the National Museum. Melbourne.

(With Plates LXXXIII.-LXXXV.).

[Read 8th December, 1910].

Introduction.

In the course of preparing a Catalogue of Type Fossils in the National Museum, some difficulties arose with regard to the names of our fossil species of the genus *Limopsis*. The separation of species in this genus is somewhat intricate on account of the closely graduated characters of some of the forms, although they can generally be grouped around certain central types. Furthermore, the genus seems to have been remarkably susceptible to any slight differences in the local surroundings, and to the nature of the sediments which were laid down in the various habitats. The evidence gathered from a consecutive study of the range and variation of species of this genus throughout the Victorian Tertiaries tends to show that the Tertiary sedimentation in this part of the world was rapid and continuous from the base to the summit. In other words, the species to which our fossil examples pertain are, generally speaking, persistent almost throughout the series; and in two important cases there are no palaeontological gaps occurring which allow the appearance from foreign sources of any forms distinct in shape or ornament, our species being traced from point to point in all their gradations.

Undoubtedly the central type-form of the genus is closely allied to that which Sir F. McCoy identified with the commonest

of our Tertiary examples of *Limopsis*, viz., *L. aurita*, Brocchi sp. It will be seen, however, in the detailed description, that the Patagonian and New Zealand species, *L. insolita*, Sow. sp., is closer to the Australian form, and, indeed, specifically identical.

In the present revision the relationships of the living Victorian and kindred species of the genus have been discussed; and it may here be suggested that the trouble of making a further and general comparison of the living with the fossil fauna of the Australian marine areas would be amply repaid by the acquisition of a correct knowledge of the percentage relations one to the other.

The specific names it is proposed to adopt in this paper are the following:—

Name.	Salient Characters.
<i>L. morningtonensis</i> , Pritchard	- Valves depressed, subquadrate; concentric ribs accentuated. Ornament in later stage sectinate.
<i>L. maccoyi</i> , sp. nov. (= <i>L. belcheri</i> , McCoy, non Adams and Reeve)	- Valves depressed, long-ovate, oblique; radial ribs accentuated. Ornament fimbriate.
<i>L. multiradiata</i> , Tate	- Valves nearly as above, not so oblique; radial ribs bifurcating. Ornament margaritate.
<i>L. beaumariensis</i> , sp. nov. (= ? <i>L. forskali</i> , Adams, <i>fide</i> Tate)	- Valves subtrigonal, ventral border long, moderately deep to shallow. Ornament nearly as in <i>L. maccoyi</i> , but cancellate.
<i>L. insolita</i> , G. Sowerby, sp.	- Valves deep, subovate, oblique, occasionally subtrigonal; with well-marked concentric laminae, crossed by fine, pseudo-divergent striae. Ornament malleate.

Description of Species.

LIMOPSIS MORNINGTONENSIS, Pritchard.

(Plate LXXXIII., Fig. 1; Pl. LXXXV., Fig. 7).

L. morningtonensis, Pritchard, 1901, Proc. R. Soc. Vict. vol. XIV., N.S., pt. I., p. 24, pl. II., Figs. 6, 6a.

Abridged Description (for full details see above).—Shell roundly quadrate, depressed; slightly oblique, with a small but

prominent acute and incurved umbo. Hinge-line nearly straight. Ligament pit triangular, well marked. Teeth, 5-9 anterior; 4-7 posterior, unequal, median strongest. Internal margin of shell broad, flat; interior finely radiately striate. Exterior with strong concentric ridges, crossed by very faint striae. Type, height, 14 mm.; length, 12.5 mm.

Distribution.¹—Balcombian.—Balcombe's Bay; Grice's Creek; Altona Bay Coal Shaft; Muddy Creek (Lower Beds) near Hamilton; Gellibrand River; Orphanage Hill, Geelong; Skinner's, Mitchell River, Gippsland.

Janjukian.—Batesford; near Griffin's Farm, Moorabool River; below Curdie's Steps; Fishing point, R. Aire.

Observations.—This species is a comparatively rare form, and is not easily mistaken for any of the other species, except it be the young forms of *L. maccoyi*. The distinguishing characters of the latter are the strong radial riblets, the fimbriate ornament and the greater obliquity of the shell.

LIMOPSIS MACCOYI, sp. nov.

(Pl. LXXXIII., Fig 2; Pl. LXXXV., Fig. 8).

L. belcheri, McCoy (non Adams and Reeve), 1875, Prod. Pal. Vict., Dec. II., p. 25, pl. XIX., Figs. 8, 9.

Relationships.—Not a little confusion formerly existed regarding the identification of the recent species of *Limopsis* ascribed by McCoy to *L. belcheri*. This has now been satisfactorily settled, so far as the living Australian examples are concerned, by Mr. Chas. Hedley.² The name of the living form now stands as *L. tenisoni*, T. Woods (syn. *L. bassi*, E. A. Smith). The species *L. belcheri*, Adams and Reeve, is a distinct, although related form, from the Cape of Good Hope.

The fossil species common in our Balcombian strata, and occasionally found in the Janjukian and Kalimnan, bears a general resemblance both to *L. belcheri* and *L. tenisoni*. It is

¹ The sequence of the Balcombian and Janjukian Series here followed is the same as that adopted by Messrs. Tate and Dennant, viz., the Balcombian as the older. The present view is strongly supported by palaeontological evidence from the Mallee borings now under description, and also by a close study of the microzoa of the Tertiaries of Victoria and elsewhere.

² Mem. Australian Mus., No. iv., 1902, p. 297.

specifically distinct from the recent *L. tenisoni* in the following particulars :—

	Outline.	Ornament.	Dental Armature
<i>L. maccoyi</i> -	Longovate, very oblique in ger-ontic stage.	Radial stronger than concentric, the latter being wavy and fimbriate.	Teeth short, curved, comparatively few.
<i>L. tenisoni</i> -	Roundly ovate, oblique in ger-ontic stage.	Radial ornament strong, some undulose; interspaces occupied by fine, closely set bars, not so wavy as in <i>L. maccoyi</i> .	Teeth longer, more numerous.

Ligament pit in the fossil species usually smaller.

The description of this form by McCoy, under the name of *L. belcheri* (loc. supra cit.) is so full and precise as to obviate any further reference to its specific characters here. It may, however, be remarked in passing, that specimens in the neanic stage usually show a crenulated inner margin, as in the northern form, *L. aurita*; but this character is lost in the later development of the shell.

This fossil form appears to be the progenitor of the living species, as shown by its shape, and also by the general type of ornament, which in *L. tenisoni* is less redundant, the fimbriation being reduced to beads on the riblets, and to curved bars in the interspaces.

The differences between the Balcombian forms¹ and the living are so marked as to warrant a new name, and hence the shell termed *L. belcheri* by McCoy, and later confused by various authorities with some other tertiary shells of the same genus, is here re-named *L. maccoyi* in honour of its first describer.

Both *L. morningtonensis*, as before stated, and *L. multi-radiata*, are somewhat related in outline, the latter being principally distinguished by its interrupted and bifurcated ribs.

Distribution.—Balcombian.—Balcombe's Bay and Grice's Creek, Port Phillip; Gellibrand River, three miles W. of mouth (G.S.V.).

Janjukian.—Bird Rock Cliffs near Torquay (G.S.V.), very rare.

¹ The Kalimnan forms are smaller and are probably annectant with the recent species. This is borne out by the intermediate character of the surface ornament.

Kalimnan.—*Beaumaris* (G.S.V.), rare; the majority of the shells referred to as *L. belcheri* from Moorabbin (= *Beaumaris*) by McCoy (loc. supra cit., p. 26), are herein described as a new species, *L. beaumariensis*; it was formerly doubtfully identified with the Japanese shell, *L. forskali*, Adams, to which it bears some affinity. Also "Forsyth's," Grange Burn, near Hamilton, and "McDonald's," Muddy Creek (F. C. coll.).

LIMOPSIS MULTIRADIATA, Tate.

(Pl. LXXXIV., Fig. 4; Pl. LXXXV., Fig. 10).

L. multiradiata, Tate, 1886, Trans. R. Soc. S. Austr., Vol. VIII., p. 135, pl. XII., Figs. 1a, b. G. F. Harris, 1897, Cat. Tert. Moll. in Brit. Mus., pt. I., Austr. Tert. Moll., p. 346.

This species is allied to *L. maccoyi*; but is distinguished by its bifurcating riblets and the wavy, tessellated ornament. It is also rounder in outline than either *L. maccoyi* or *L. insolita*.

Distribution.—Localities all in South Australia. Adelaide Bore; Aldinga; Ninety Mile Desert.

LIMOPSIS BEAUMARIENSIS, sp. nov.

(Pl. LXXXIV., Fig. 6; Pl. LXXXV., Fig. 12).

L. forskali, A. Adams (*fide* Tate), 1898, Trans. R. Soc. S. Aust., Vol. XXII., p. 68, list name.

Description.—Shell subtrigonal, never very oblique, usually thick, comparatively tumid. Nearly equilateral up to the neanic stage, becoming slightly oblique in the ephebic and gerontic phases. Ligament pit large and triangular. Hinge-line strongly arched. Type specimen with 9 anterior and 9 posterior teeth; another specimen with 7 anterior and 8 posterior teeth. Ornament consisting of well marked, slightly undulating primary riblets, with from 0-4 secondary riblets in the interspaces, crossed by fainter, equidistant growth-lines, producing a distinct cancellated surface. Interior of valve finely striate; internal margin flat, smooth. A fairly constant variety is often

met with at "McDonald's," Muddy Creek, and other Kalimnan localities, distinguished by its thin, depressed form, apiculate umbo and stronger concentric striae. This might be appropriately termed var. *depressa*, nov.

Dimensions.—Type: Height, 20.25 mm.; length, 21 mm.; depth of valve, 6 mm.; length of hinge-line, 9.25 mm.; height of ligament pit, 1.75 mm. Smallest sample: Height, 11 mm.; length, 11.5 mm. Locality of type, Beaumaris, from a bed of white clay (Kalimnan), G.S.V. coll.

Relationships.—Amongst a dozen examples of the genus *Limopsis* from Beaumaris labelled as *L. belcheri* by McCoy, in the National Museum collection, two are undoubtedly referable to *L. maccoyi*, whilst the remainder, which are deeper shells of a subtrigonal form and of a stout build, belong to the species now described as *L. beaumariensis*. The dental armature is strong, although the number of teeth is the same as in *L. maccoyi*, from 15-19. Compared with *L. insolita*, that species rarely has more than 14. The ligament pit is long and deep as in *L. insolita*, but the ornament is clearly that of *L. maccoyi*. This form is extremely interesting as pointing to a local hybridisation of two tolerably distinct shells.

Observations.—Professor Tate, in objecting to McCoy's identification of the recent Australian *Limopsis* with the Cape of Good Hope species, *L. belcheri*, suggested its alliance to *L. forskali*, Adams.¹ In subsequent lists Prof. Tate records *L. forskali* as occurring in the Tintinnarra Bore, S. Australia, in pre-Kalimnan strata.² This identification of the Kalimnan fossil was perpetuated by later authors, presumably by comparison with Tate's examples. In the Dennant collection in the National Museum some very fine shells of the above species from the younger Muddy Creek beds (Kalimnan) are labelled "*L. forskali*"; whilst shells of the form now referred to as *L. maccoyi*, from the older Muddy Creek beds (Balcombian), were labelled by the late Mr. Dennant as "*L. forskali*, var." There is no doubt, therefore, as to the shell ascribed by Tate to *L. forskali*, since Mr. Dennant had carefully compared his specimens with Tate's named examples.

¹ Trans. Roy. Soc. S. Aust., vol. xxi., 1897, p. 48.

² Ibid., vol. xxii., 1898, p. 68.

With regard to *L. forskali*, this shell was described by Adams from recent examples (dead shells), from the shores of Japan.¹ No figure of the species was given, and, although the description agrees in many particulars with the present form, the Japanese shell differs in having the radial riblets alternately large and small, whereas the radii in the fossil species shows every gradation between simple primary riblets and intermediate riblets from 1 to 4 in number. In the absence of authentic specimens of *L. forskali*, and bearing in mind the difference in ornament noticed above, it appears safer to designate our common Kalimnan species by a distinctive name.

The examples of *L. beaumariensis* from the Kalimnan series of Grange Burn and McDonald's, near Hamilton, are generally much abraded and ironstained, and in some cases the shell surface is so highly polished as to show that they have been undoubtedly subjected to wind erosion.

Distribution.—The distribution of the above species does not coincide with that of *L. forskali* as recorded by Dennant and Kitson² in their Barwonian group of localities, since the former author had compared *L. belcheri* (= *L. maccoyi*, sp. nov.) with that form (*teste* Dennant Coll.).

Barwonian.—Lake Bullenmerri, Camperdown. G.S.V. coll.

Kalimnan.—Beaumaris; McDonald's, Muddy Creek; Forsyth's, Grange Burn; Jemmy's Point, Gippsland (in Dennant coll. as "*? Limopsis insolita*, var.").

LIMOPSIS INSOLITA, G. Sowerby sp.

(Pl. LXXXIV., Fig. 5; Pl. LXXXV., Fig. 11).

Trigonocoelia insolita, G. Sowerby, 1846, in Darwin, Geol. Obs. S. America, p. 252 (2nd ed. 1876, p. 608), Pl. II., Figs. 20, 21.

Limopsis insolita, Sow. sp., Zittel, 1864, Reise der "Novara," Vol. I., Abth. II., p. 48, Pl. XIII., Fig. 1.

L. aurita, McCoy (non Brocchi sp.), 1875, Prod. Pal. Vict., Dec. II., p. 23, Pl. XIX., Figs. 5-7.

L. insolita, Sow. sp., Harris, 1897, Cat. Tert. Moll. Brit. Mus., Pt. I., Australasia, p. 344.

¹ Proc. Zool. Soc. Lond., 1862, p. 230.

² Rec. Geol. Surv. Vict., vol. i., pt. 2, 1903, p. 122.

Relationship to L. aurita.—The Victorian species generally referred to under the name of *L. aurita*, Brocchi sp., is closely related to that well-known European type of shell ; but it differs in the following particulars from Brocchi's original figure and description.¹ The shell is heavier when in the ephebic and gerontic stages ; is more ovate, as well as more oblique, rarely being subtrigonal,² as in Brocchi's figure of the Pliocene form ; and is peculiarly striate in an apparently double divergent series on each concentric lamina. The original descriptions of Brocchi and G. Sowerby are here given.

“*Arca aurita*,” Brocchi.

Shell ovate, oblique, narrow above ; concentrically ridged, rugae crowded, elevated. Hinge-line ear-shaped, with a distinct triangular pit. Margin entire.

“*Trigonocoelia insolita*,” G. Sowerby.

Shell subovate, thickened, very oblique, smooth ; ligament pit trigonal, laterally elevated ; teeth few, large.

In neither of these original descriptions is there any mention of radial striae or ribs. With regard to *L. aurita*, judging from a fine series of specimens in the National Museum collection, it is clear that there has been either great latitude in the identification of specimens ranging from the Middle Oligocene to Pliocene, or on the other hand, several species have been confused under the one name. For instance, specimens of *L. aurita* (ex. Krantz coll.) from the Middle Oligocene of Flonheim, Rhenish Hesse, are orbicular to ovate-oblique shells. They are moderately deep, with the surface concentrically ridged, the flats of the ridges being radially striate. The inner margin is flat, but crenulate on the inner edge. Again, examples from the White Crag (Lower Pliocene) of Orford, Suffolk, England,

1 “*Arca aurita*,” Brocchi. *Conchiologia Fossile Subapenninae*, 1814, p. 485, pl. xi., fig. 9.

2 In some specimens of *L. insolita*, between the brephic and neanic stages the shell undergoes a change in outline from a broad, semicircular to a decidedly oblique form. This imparts a subtrigonal aspect to the earlier half of a full-grown shell, but not to such a degree as in Brocchi's type of *L. aurita*.

are somewhat similar in shape to the preceding, but are smaller, and rounder in outline. The shell is also radially striate, as in the European Oligocene specimens. In these Pliocene specimens the inner margin of the shell is smooth, in this feature differing from the older, Oligocene, examples mentioned above. In this minor character it agrees with the Southern Hemisphere type of shell.

It is probable, judging from the above comparisons, that both Broochi's and Sowerby's specimens were somewhat worn, since typical shells of both species from type localities show the radial striae. Taking the evidence as a whole, there is good ground for regarding the Northern and Southern types as distinct; *L. aurita* being a rounder form, with simple striae or radial punctae, on the concentric rugae.

The Identity of the Southern Forms of the "aurita" type with L. insolita.—The most important distinctive feature between the Northern and Southern forms of the "aurita" type of *Limopsis* is the nature of the radial striae. As seen in the Victorian (Spring Creek) specimens, and also verified in the New Zealand (Oamaru) shells, this radial striation is complex, the sides of the pits producing a secondary and divergent series. McCoy¹ refers to it as follows:—

"Well-preserved specimens show under the lens close, obtuse, radiating striae, about twice their thickness apart on the flat portion of the concentric laminae, each seeming to widen and dichotomise towards the edge, which it does not pass (about 10 in 1 line at 3 lines from the beak)." By reference to Plate LXXXV., Fig. 11, it will be at once seen that this divergent striation is due to the effect of the pitted ornament. This peculiar character of the pitting is not seen in the European shell, *L. aurita*, which has simple striae equally spaced with the concentric rugae, and consequently imparting a tessellated appearance to the shell-surface.

The Victorian, South Australian, Tasmanian, New Zealand, and Patagonian specimens of this type, tested by the above and the other characters mentioned, are thus seen to belong to *L. insolita*. The originally described examples came from the

1. Loc. supra cit., p. 23.

Santa Cruz beds of Patagonia. To settle any disputed points as to the relationship of our Victorian (Janjukian) species, the writer has been helped by the kindness of Mr. Chas. Hedley, the Assistant Curator of the Australian Museum, who has presented to the National Museum collection a typical example of the shell from the same series whence the original type was obtained. Sowerby, in his description of *L. insolita* says,¹ it is "smooth on the outside, and destitute of radiating ridges." The Santa Cruz specimen to which I have referred shows, however, that the shell is relieved by concentric lines of growth, and these are crossed by faint, but undoubted incised radii, which are more pronounced on the edges of the growth-lines; and on one part, on the posterior angle, the pseudo-divergent character of the striae is visible.

The New Zealand specimens, of which we also have examples in the Museum collection, bear the same characters as stated above. Zittel's specimen seems to have been a particularly smooth one, as, in describing this shell in his "Fossile Mollusken und Echinodermen aus Neu Seeland,"² he says:—"Die Aussenseite trägt keine Radialstreifen oder Rippen, ist fast glatt und nur mit einer schwachen concentrischen Zuwachstreifung bedeckt."

To give some idea of the prevailing confusion in regard to the identity of specimens of this genus by later authors, we may mention that Prof. Tate quotes McCoy's determination of *L. aurita* for the specimens from Mornington, and his own, from Muddy Creek (at neither of which places, by the way, does it occur); Bird Rock (McCoy) and Table Cape, Tasmania (R. M. Johnston). Further, under *L. insolita* in the same work, Tate correctly gives the localities of Aldinga Bay, Adelaide Bore, New Zealand and Patagonia. Another author, G. F. Harris refers specimens from S. Australia and New Zealand to *L. insolita*³; whilst on p. 346 of the same work he records *L. aurita* as from the Miocene of Awamoa, New Zealand, a typical locality for *L. insolita*. With reference to the latter species he remarks—"There appears to be no conchological difference between the European and Australasian examples of

1 Loc. cit., 2nd ed., p. 608.

2 Reise der "Novara." Geol. Theil., vol. i., Abth. ii., 1864, p. 48.

3 Cat. Tert. Moll., Brit. Mus., pt. i., Australasia, 1897, p. 344.

this variable species. Typically the shell is not so oblique as *L. belcheri*; radial lineations are barely perceptible (or absent) in many individuals."

Distribution.—In Messrs. Dennant and Kitson's List of Victorian, S. Australian and Tasmanian Fossils previously referred to, the records under *L. aurita* Brocchi ? are Glen Aire, Shelford, Corio Bay, Table Cape and Beaumaris; and in a footnote (loc. cit. p. 122) the species is stated to be "probably a synonym of *L. morningtonensis*." In the Dennant collection that author has referred examples from these localities to the latter species. In the present author's opinion, from an examination of those shells, they are referable to *L. insolita*, with the exception of those recorded from Beaumaris, which are typical *L. beaumariensis*, and from Shelford, where they appear to belong to *L. maccoyi*.

Balcombian.—Corio Bay.

Janjukian.—Aldinga; Lake Alexandrina; Ninety Mile Desert; Table Cape; Spring Creek (Torquay); Brown's Creek; Glen Aire; Cape Otway; Hamilton Creek; Aire Coast; Birregurra; Maude.

SYNOPSIS OF DISTRIBUTION.

<i>L. morningtonensis</i> , Pritchard	-	Balcombian.	Moderately common; typical.
<i>L. maccoyi</i> , sp. nov.	- - -	Balcombian.	Common; typical.
		Janjukian.	Rare.
		Kalimnan.	Moderately rare; passing into <i>L. tenisoni</i> (living).
<i>L. multiradiata</i> , Tate	- - -	A	very restricted modification of <i>L. maccoyi</i> ; confined, so far as known, to the Lower Aldingan series (Janjukian).
<i>L. beaumariensis</i> , sp. nov.	- - -	Barwonian	(probably Janjukian). Not common.
		Kalimnan.	Typical and common. Apparently an intermediate link between <i>L. maccoyi</i> and <i>L. insolita</i> .
<i>L. insolita</i> , G. Sowerby, sp.	-	Balcombian	(high in series).
		Janjukian.	Throughout the series and typical. No characteristic specimens seem to occur in the Kalimnan series.

REMARKS ON THE PHYLOGENETIC RELATIONSHIPS OF THE AUSTRALIAN SPECIES OF LIMOPSIS.

L. cancellata, Reeve,¹ from Queensland, has a surface-ornament approaching that of *L. beaumariensis*, but in outline the shell is equilateral as in *Glycimeris*, instead of subtrigonal.

L. tenisoni, var. *penelevis*, Verco,² is evidently a descendant of *L. morningtonensis*, Pritch., but with a larger and heavier shell.

The young shells of *L. tenisoni* are closely comparable with the young (neanic stage) of *L. maccoyi*; the distinctive characters not predominating until the brephic stage.

L. vixornata, Verco,³ is of the *L. morningtonensis* type of surface ornament, but its shell is more equilateral and depressed.

L. eucosmus, Verco,⁴ appears to have descended from *L. insolita*, with which it agrees in the contused ornament, with pseudo-divergent striae. This character, by the way, is not very distinctly shown in the original figure. Its outline is sub-orbicular, as distinct from the sub-trigonal to oblique shell of *L. insolita*. We thus have in the past and present Australian fauna the following types as distinguished by their surface ornament:—

Ornament.	Fossil.	Recent.
Pectinate	<i>L. morningtonensis</i>	<i>L. tenisoni</i> , var. <i>penelevis</i> <i>L. vixornata</i> .
Fimbriate	<i>L. maccoyi</i>	Young of <i>L. tenisoni</i> .
Malleate	<i>L. insolita</i>	<i>L. eucosmos</i> .
Cancellate	<i>L. beaumariensis</i> (also <i>L. aurita</i> , Brocchi, sp. of European types)	<i>L. cancellata</i> .
Latestriate	————	<i>L. tenisoni</i> .

In concluding these notes I would express my sincere thanks to Mr. C. J. Gabriel for invaluable aid in regard to typical recent specimens.

1 *Pectunculus cancellatus*, Reeve, Proc. Zool. Soc. Lond., 1843, p. 188. Id., Conch. Icon., 1843, pl. vii., fig. 39.

2 Trans. Roy. Soc. S. Aust., vol. xxxi., 1907, p. 218, pl. xxvii., fig. 5.

3 Ibid., p. 219, pl. xxvii., fig. 1.

4 Ibid., p. 219, pl. xxvii., fig. 2.

EXPLANATION OF PLATES LXXXIII.—LXXXV.

PLATE LXXXIII.

Fig. 1.—*Limopsis morningtonensis*, Pritchard. A group of three shells, showing interior of left valve and exterior of left and right valves. Balcombian Series; Fyansford. (Dennant coll. Nat. Mus.)

Fig. 2.—*L. maccoyi*, sp. nov. (= *L. belcheri*, McCoy, non Adams and Reeve). A group of shells showing interior of left valve, and exterior of two other left valves. Balcombian Series; Grice's Creek, Port Phillip (Coll. of Geol. Surv. Vict. in Nat. Mus.)

Fig. 3.—*L. tenisoni*, T. Woods. Interior of left, and exterior of right valves. Living; dredged from Western Port Bay. (Coll. C. J. Gabriel.)

About natural size.

PLATE LXXXIV.

Fig. 4.—*L. multiradiata*, Tate. Exterior of right valve. Janjukian Series; Aldinga. (Dennant coll. Nat. Mus.)

Fig. 5.—*L. insolita*, Sowerby sp. The three upper figures, interior of left valve and exterior of right and left valves, are from the Janjukian Series of Bird Rock, near Torquay (Geol. Surv. Vict. Coll. in Nat. Mus.). The lower figure is a left valve in the gerontic stage, from the same series at Aldinga, S. Australia (Dennant coll. in Nat. Mus.).

Fig. 6.—*L. beaumariensis*, sp. nov. (= *L. cf. forskali*, Tate non Adams). Interior of right valve in gerontic stage and exterior of two left valves in gerontic and ephebic stages. Kalimnan Series; Beaumaris Cliffs. (Coll. of Geol. Surv. Vict. in Nat. Mus.).

About natural size.

PLATE LXXXV.

Fig. 7.—*L. morningtonensis*, Pritchard. Surface ornament taken at 4 mm. below umbo. The shell is probably between the ephebic and gerontic stages. Balcombian Series; Fyansford (Dennant coll.).

- Fig. 8.—*L. maccoyi*, sp. nov. Surface ornament from 15 mm. below umbo. Shell in the ephebic stage. Balcombian Series; Grice's Creek. (G.S.V. coll.)
- Fig. 9.—*L. tenisoni*, T. Woods. Surface ornament from anterior slope of valve in the ephebic stage. Living; dredged off S. Australia. (C. J. Gabriel coll.)
- Fig. 10.—*L. multiradiata*, Tate. External surface ornament. Janjukian Series; Aldinga, S. Australia. (Dennant coll.)
- Fig. 11.—*L. insolita*, Sow. sp. External surface ornament from middle of a right valve in the ephebic stage. Janjukian Series; Bird Rock Cliffs, Torquay (G.S.V. coll.)
- Fig. 12.—*L. beaumariensis*, sp. nov. Surface ornament from middle of valve in the ephebic stage. Kalimnan series; Beaumaris Cliffs, Port Phillip. (G.S.V. coll.)

All figures magnified 9 diameters.



Chapman, Frederick. 1911. "A revision of the species of *Limopsis* in the Tertiary beds of Southern Australia." *Proceedings of the Royal Society of Victoria* 23(2), 419–432.

View This Item Online: <https://www.biodiversitylibrary.org/item/34777>

Permalink: <https://www.biodiversitylibrary.org/partpdf/301874>

Holding Institution

MBLWHOI Library

Sponsored by

MBLWHOI Library

Copyright & Reuse

Copyright Status: NOT_IN_COPYRIGHT

This document was created from content at the **Biodiversity Heritage Library**, the world's largest open access digital library for biodiversity literature and archives. Visit BHL at <https://www.biodiversitylibrary.org>.